propagated the length of the cable, and the algorithm resumes (return to the beginning).

1. What is the optimal probability to use for flipping the coin? In other words, what should p be to maximize the probability that exactly one computer transmits?
2. What is the probability of one computer transmitting when this optimal value of p is used as the number of computers grows to infinity?
3. Using this optimal probability, what is the average number of coin flips that will be necessary to resolve the access so that one computer successfully transmits?
4. Evaluate this algorithm. Is it realistic? Is it efficient?

Problem 6.32: Repeaters

Because signals attenuate with distance from the transmitter, **repeaters** are frequently employed for both analog and digital communication. For example, let's assume that the transmitter and receiver are D m apart, and a repeater is positioned halfway between them (Figure 6.42). What the repeater does is amplify its received signal to exactly cancel the attenuation encountered along the first leg and to re-transmit the signal to the ultimate receiver. However, the signal the repeater receives contains white noise as well as the transmitted signal. The receiver experiences the same amount of white noise as the repeater.

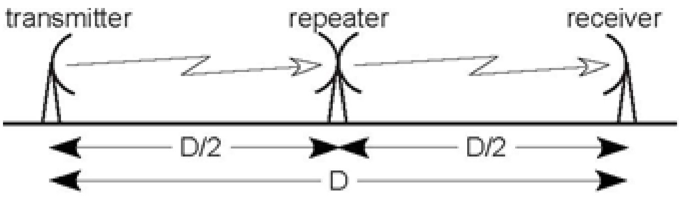

Figure 6.42

1. What is the block diagram for this system?
2. For an amplitude-modulation communication system, what is the signal-to-noise ratio of the demodulated signal at the receiver? Is this better or worse than the signal-to-noise ratio when no repeater is present?
3. For digital communication, we must consider the system's capacity. Is the capacity larger with the repeater system than without it? If so, when; if not, why not?

Problem 6.33: Designing a Speech Communication System

We want to examine both analog and digital communication alternatives for a dedicated speech transmission system. Assume the speech signal has a 5 kHz bandwidth. The wireless link between transmitter and receiver is such that 200 watts of power can be received at a pre-assigned carrier frequency. We have some latitude in choosing the transmission bandwidth, but the noise power added by the channel increases with bandwidth with a proportionality constant of 0.1 watt/kHz.

1. Design an analog system for sending speech under this scenario. What is the received signal-to-noise ratio under these design constraints?
2. How many bits must be used in the A/D converter to achieve the same signal-to-noise ratio?
3. Is the bandwidth required by the digital channel to send the samples without error greater or smaller than the analog bandwidth?